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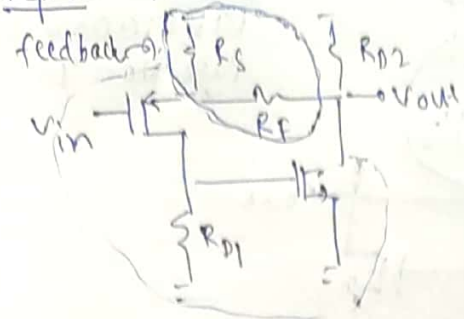
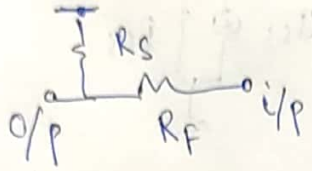
3. **Step 1:** Feedback network

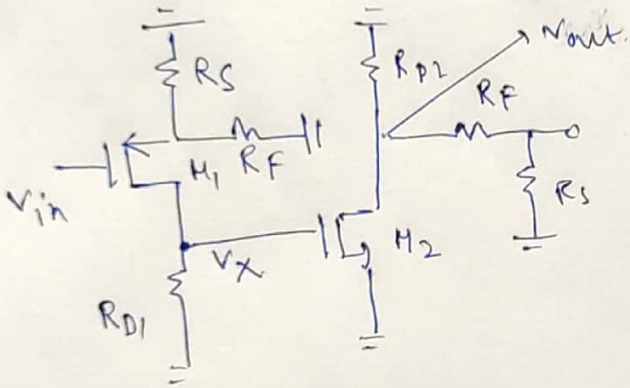


Step 2: Forward amplifier has M_1, M_2, R_{D1} and R_{D2} and R_S

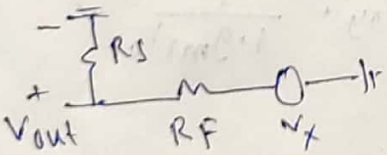
Step 3: Input and output port of feedback



Step 4: Breaking loop



Step 5: Feedback factor



$$\frac{V_{out}}{V_X} = \frac{R_S}{R_S + R_F} = \beta$$

Step 6: Open loop parameters

$$\frac{V_X}{V_{in}} \approx -\frac{R_{D1}}{\frac{1}{g_{m1}} + R_S \| R_F}$$ [Here r_{o1} is assumed large]

$$\frac{V_{out}}{V_X} = -g_{m2}\left[R_{D2} \| (R_F + R_S) \| r_{O2}\right]$$

$$A_V = \frac{g_{m2}\left[R_{D2} \| (R_F + R_S) \| r_{O2}\right] R_{D1}}{\frac{1}{g_{m1}} + R_S \| R_F}$$

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$R_i = \infty$.

$R_o = R_{D2} \,||\, (R_f + R_s) \,||\, r_{o2}$

step 2: Closed loop parameters

$$A_{if} = \frac{A_v}{1 + A_v\beta} \qquad A_v = \frac{g_{m2} R_{D1} \left[R_{D2} \,||\, (R_f + R_s) \,||\, r_{o2}\right]}{\frac{1}{g_{m1}} + R_s \,||\, R_f}$$

$$R_{if} = R_i (1 + A_v\beta)$$

$$R_{of} = \frac{R_o}{1 + A_v\beta} \qquad \beta = \frac{R_s}{R_s + R_f}$$

Thus the expression the expressions are

$$A_{vf} = \frac{\dfrac{g_{m2} R_{D1} \left[R_{D2} \,||\, (R_f + R_s) \,||\, r_{o2}\right]}{\frac{1}{g_{m1}} + R_s \,||\, R_f}}{1 + \dfrac{R_s}{R_s + R_f} \dfrac{g_{m2} R_{D1} \left[R_{D2} \,||\, (R_f + R_s) \,||\, r_{o2}\right]}{\frac{1}{g_{m1}} + R_s \,||\, R_f}}$$

$R_{if} = \infty$

$$R_{of} = \frac{R_{D2} \,||\, (R_f + R_s) \,||\, r_{o2}}{1 + \dfrac{R_s}{R_s + R_f} \dfrac{g_{m2} \left[R_{D2} \,||\, (R_f + R_s) \,||\, r_{o2}\right] R_{D1}}{\frac{1}{g_{m1}} + R_s \,||\, R_f}}$$